Integrated Control in Citrus Fruit Crops
IOBC wprs Bulletin Vol. 29(3) 2006
pp. 71 - 74

Two native pupal parasitoids of *Ceratitis capitata* (Diptera, Tephritidae) found in Spain

J.V. Falcó, E. Garzón-Luque, M. Pérez-Hinarejos, I. Tarazona, J. Malagón, F. Beitia
Instituto Valenciano de Investigaciones Agrarias, Unidad Asociada IVIA-CIB, Laboratorio de Entomología, Apartado Oficial, 46113 Montcada, Valencia, Spain

Abstract: Searching native parasitoids of *Ceratitis capitata* is one of the activities carried out in the Valencian Community in plots of citrus and other fruit trees. Adults of two different species of hymenopterous insects have been obtained from medfly puparia reared under laboratory conditions. The pteromalids *Spalangia cameroni* Perkins and *Pachycrepoideus vindemmiae* (Rondani) have been identified as idiobiont pupal parasitoids of the Medfly.

Key words: Tephritidae, Pteromalidae, Medfly, *Ceratitis capitata*, native parasitoid, *Spalangia cameroni*, *Pachycrepoideus vindemmiae*, Valencian Community.

Introduction

Ceratitis capitata (Wiedemann, 1824) is considered a key pest of stone and citrus fruits in several parts of the world. The medfly has became a cosmopolitan species with a wide range of host plants as a result of its great capacity of dispersion, adaptability and high rate of reproduction

The life cycle includes four phases that begin with the egg oviposited under the fruit skin. It continues with the larvae developed inside the pulp of the fruit. The larva of third instar falls down to the soil where it buries and becomes pupa. Adults emerge from the pupae in a few days.

In the Valencian Community (East coast of Spain) this insect has became an endemic pest since the 30s, what making necessary to take measures of control to avoid the economic losses caused in the citrus sector. Nowadays, the citrus areas affected by the medfly are under a program of control based in a monitoring system (pheromone & bait traps), terrestrial and aerial treatments with chemicals (malathion+protein), sterilizing traps and the use of sterile insect techniques (sterile males) (Castañera, 2003).

As a result of the importance and interest of this pest in Spain, a multidisciplinary project with different research centres began in 2003. This project is based on an integrated pest management applied before and after the harvest. Biological control is included in the pre-harvest measures.The Valencian Institut for Agricultural Research (IVIA) takes part in a sub-project which aims at studying the possibilities of use of parasitoids against the medfly in the mediterranean areas of Spain. For this purpose, the IVIA imported two parasitoids from Hawaii that were being used satisfactorily in other parts of the world: the Hymenoptera Braconidae *Fopius arisanus* (Sonan, 1932) and *Diachasmimorpha tryoni* (Cameron, 1911), egg and larva parasitoids respectively (Falcó *et al.*, 2003a,b,c).Other parasitoids of *Ceratitis capitata* such as *Aganaspis daci* (Weld, 1951), *Habrobracon hebetor* (Say, 1836), *Bracon laetus* Wesmael, 1838 and *Psyttalia concolor* (Silvestri, 1914) have been found in the Mediterranean Basin (Dean, 2003; Papadopoulos & Katsoyanos, 2003) but there are no records of native parasitoids detected in the Iberian Peninsula. Our work group has initiated a

deep search of native parasitoids of the Medfly in the Valencian citrus area in order to find insects that could carry out biological control of *C. capitata*.

Materials and methods

The search of native parasitoids began with the selection of eight plots placed all over the Valencian area (East coast of Spain), all of them not treated with chemical pesticides. The plots and fruits were the following: 1. Segorbe (Castellón): cherry, pear, apricot, persimmon; 2. Moncada (Valencia): peach, loquat, apricot, nectarine; 3. Albalat dels Tarongers (Valencia): citrus; 4. Bétera (Valencia): citrus, apple, fig, peach; 5. Lliria (Valencia): loquat, fig, pear, peach, apricot; 6. L'Alcudia (Valencia): citrus, persimmon; 7. Alpatró (Alicante): cherry; 8. Altea (Alicante): loquat.

The methodology used was based on the collection of fruits attacked by the medfly. These fruits were put on trays with inorganic substrate and placed under the trees to get the developed larvae which could fall down and pupate in that substrate. Eggs, larvae, and pupae were left on the trays in order to allow the possible parasitic action of any parasitoid in the area that could work over the different phases of the medfly. Five days old pupae were collected and transferred to the Entomology laboratory so that they could develop under regulated climate conditions, at 21-26ºC, 65-90 % RH and 16:8 (L:D), until the emergence of medfly as well as parasitoid adults. If there was a lack of attacked fruits, young pupae reared in laboratory were placed in the orchards, following the same steps until the adults emerged.

Results and discussion

Two native parasitoids were detected. The first native parasitoid found was located in the plot of Bétera (4) where sampling of attacked fruits and reared lab pupae was carried out weekly during the period from September until November, 2003. In a sample of september-2003 several parasitoids emerged from medfly pupae in the laboratory. After a precise taxonomic identification they were recognized as the species *Spalangia cameroni* Perkins, 1910, an hymenopteran pupal ectoparasitoid which belongs to the family Pteromalidae (Fig. 1). This species attacks basically diptera Muscidae and Sarcophagidae, but also the tephritid genus *Dacus* has been recorded as its host in Hawaii and Fidji islands; its geographic distribution is Pacific Islands, Central and South America (Antilles, Brazil), Asia, Africa and Europe (including Azores) (Boucek,1963)**.** It may be emphasized that 5 species of the genus *Spalangia* are recorded as parasitoid of 11 tephritid fruit-flies (Boucek, 1963). However, our finding represents the first record in the world of *Spalangia cameroni* as parasitoid of *Ceratitis capitata*.

This parasitoid is being reared under regulated climate conditions. At the moment the life cycle and several biological parameters are being studied. 11 generations with a maximum rate of 60 % of parasitism were obtained in the first year

The second native parasitoid was found in the sampling areas number 4 and 6 in the year 2004; it was again found in the field at the same searching sites in the year 2005. It was identified as the species *Pachycrepoideus vindemmiae* (Rondani, 1875), also a hymenopteran parasitoid that belongs to the family Pteromalidae (Fig. 2). Although *P. vindemmiae* is a cosmopolitan species, it has been recently recorded from Spain (Askew *et al.,* 2001). The biological features are Idiobiont Pupal Ectoparasitoid of Diptera (Muscidae, Drosophilidae, Tephritidae (including *C. capitata*) but it is also recorded as hyperparasitoid of beneficial hymenopteran (Rueda & Axtell, 1985; van Alphen & Thunissen, 1983). The species is being

used as a biological control agent of *Ceratitis capitata* in Argentina, Colombia, Hawaii and Costa Rica (Ovruski *et al.*, 2000).

Nowadays the parasitoid is being reared in the laboratory under regulated climate conditions and we obtain regularly a sufficient number of individuals to maintain the rearing. *Spalangia cameroni* represents a new record to the Spanish fauna and a new record in the world as a parasitoid of *Ceratitis capitata.* It will be studied to know its potential as a biological agent against *C. capitata*.

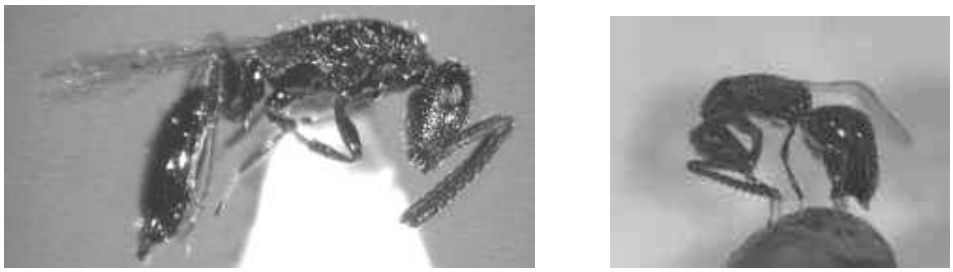

Fig. 1. *Spalangia cameroni*: habitus and oviposition on *C. capitata* pupa**.**

Fig. 2. *Pachycrepoideus vindemmiae*: habitus and oviposition on *C. capitata* pupa**.**

Acknownledgements

This work is included in the RTA Project 2003-05 *"*Integrated Control of the Mediterranean Fruit-fly, *Ceratitis capitata,* in Citrus Fruits*"* which is financed by the Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA).

References

Askew, R.R., Blasco-Zumeta, J., Pujade-Villar, J. 2001: Chalcidoidea and Mymarommatoidea (Hymenoptera) of a *Juniperus thurifera* L. forest of Los Monegros region, Zaragosa. *Monografias Sociedad Entomológica Aragonesa.* 4: 24.

Boucek, Z. 1963: A taxonomic study in *Spalangia* Latr. (Hymenoptera, Chalcidoidea). *Acta Entomologica Musei Nationalis Pragae*. 35: 429-512.

Castañera, P. 2003: Control integrado de la mosca mediterránea de la fruta, Ceratitis capitata (Wiedemann) (Diptera: Tephritidae) en cítricos. *Phytoma-España* nº 153.

Falcó, J.V., M. Pérez-Hinarejos, S. Santiago, S. Navarro, F. Beitia: 2003a. Introducción de parasitoides exóticos para el control de insectos plaga: procedimientos de importación y cuarentena. En: Capdevila- Argüelles L., B. Zilleti y N. Pérez- Hidalgo (Coords.):

Contribuciones al conocimiento de las especies exóticas invasoras. Grupo Especies Invasoras Ed. , G. E. I., Serie Técnica, 1:222- 224.

Falcó, J.V., M. Pérez, S. Santiago, A. Hermoso de Mendoza, F. Beitia: 2003b. Rearing methods of two braconids parasitoids used in the biological control of *Ceratitis capitata*. *"Integrated Control in Citrus Fruit Crops", IOBC/WPRS Bulletin*, 26(6): 99-102.

Falcó, J.V., S. Navarro, S. Santiago, M. Pérez-Hinarejos, E. Garzón, F. Beitia. 2003c: Aspectos biológicos de la cría de laboratorio de dos himenópteros parasitoides exóticos de *Ceratitis capitata*. *Phytoma – España*, nº 153.

Ovruski, S., M. Aluja, J. Sivinski, R. Wharton, 2000: Hymenopteran parasitoids on fruit-infesting Tephritidae (Diptera) in Latin America and southern United States: diversity, distribution, taxonomic status and their use in fruit fly biological control. Int. Pest Man. Rev. 5: 81-107.

Papadopoulos, N.T., B.I. Katsoyannos, 2003: Field parasitism of *Ceratitis capitata* larvae by *Aganaspis daci* in Chios, Greece. *Biocontrol*, 48: 191-195.

Stibick, J.N.L. 2003: Natural enemies of fruit flies (Tephritidae). United States Department of Agriculture. Animal and Plant Health Inspection Service. *www.aphis.usda.gov/ppq/manuals*/

Uygun Dean, N., 2003: Las plagas de los cítricos y su control mediante métodos de CIP en Turquía. Phytoma- España nº153.